

**National Operational Hydrologic Remote Sensing Center**  
**National Weather Service, NOAA**  
**U.S. Department of Commerce**  
**Minneapolis, Minnesota**

**Overview of the Center's Web Site and Products**

**[www.nohrsc.noaa.gov](http://www.nohrsc.noaa.gov)**

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## **1 Introduction**

The National Operational Hydrologic Remote Sensing Center's (NOHRSC) National Snow Analyses (NSA) provide daily comprehensive snow information for the coterminous United States. The NSA are based on modeled snowpack characteristics that are updated each weekday using all operationally available ground-based, airborne, and satellite observations of snow water equivalent, snow depth, and snow cover. The NOHRSC snow model is a multi-layer, physically-based snow model operated at 1-km<sup>2</sup> spatial resolution and hourly temporal resolution for the nation. Snow data used to update the model include observations from the NOHRSC's Airborne Snow Survey Program, NWS and FAA field offices, NWS Cooperative Observers, the Natural Resources Conservation Service SNOTEL and snow course networks, the California Department of Water Resources and Canadian snow pillow networks, and snow cover observations from NOAA's GOES and AVHRR satellites. NSA product formats include: (1) daily national and regional maps for nine snowpack characteristics, (2) seasonal, two-week, and 24 hour movie-loop animations for nine snowpack characteristics, (3) text summaries, and (4) a suite of interactive map, text, and time-series products. The NSA include information about snow water equivalent, snow depth, snow temperature, snowmelt, snowpack sublimation, sublimation from blowing snow, snow surface energy exchanges, precipitation, and weather. Most NOHRSC products are available from the NOHRSC web site. This summary provides an overview of the NOHRSC's web site and products, insight on site navigation, a summary of the available gridded products and how to obtain those gridded products that are not available through the NOHRSC web site ([www.nohrsc.noaa.gov](http://www.nohrsc.noaa.gov)).

## **2 Home Page**

The home page provides a NOHRSC site map and NWS news, organization, and search options across the top. The main menu is on the left and each menu item will be discussed in this overview. The three principle pages on the site are: (1) Snow Analyses, (2) Interactive Products, and (3) Airborne Snow Survey Program. These pages can be accessed from the side-bar menu or by depressing the appropriate picture box in the middle of the page. Below the picture boxes, a very brief National Snow Summary is given with more information provided on the Snow Analyses page.

## **3 NOHRSC Overview**

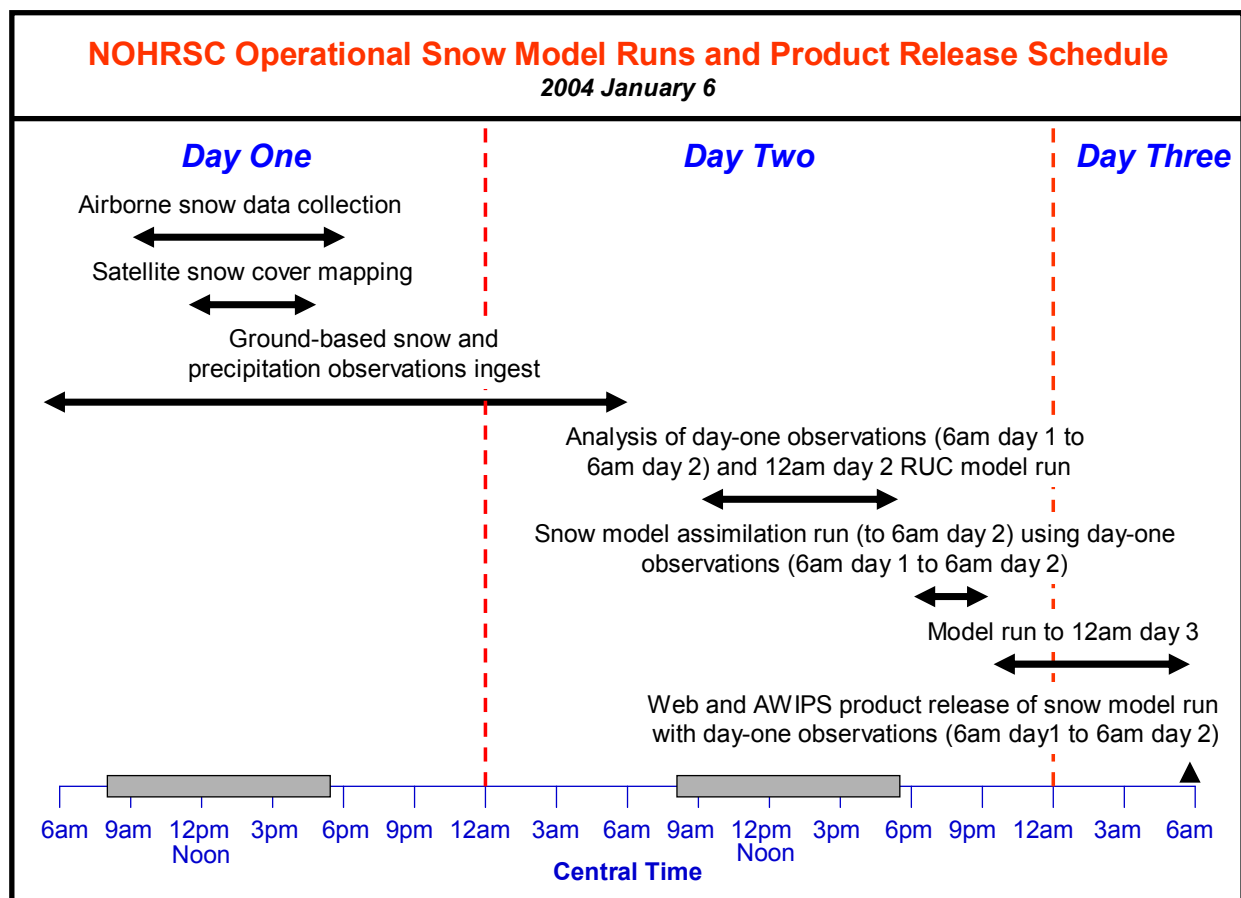
The current version of this document, in PDF format, is available directly from the NOHRSC home page side-bar menu and from the General Help Questions section of the help page.

## **4 Snow Analyses**

The NOHRSC national and regional Snow Analyses provide a daily synoptic overview of snow conditions for the coterminous U.S. as well as for the 18 U.S. snow regions at a higher resolution. The Snow Analyses are text descriptions of daily snow accumulation based on snow observations and modeled snowpack characteristics. They review both the meteorological observations of snowfall and snow on the ground as well as the snowfall and snow accumulation simulated by the NOHRSC snow model. Regions of the greatest, or most interesting, snow precipitation are highlighted in the analyses. The Snow Analyses also provide an explanation of the variance between the NOHRSC snow model state variables and observed snow conditions. The analyses review the regions across the country where observed snow data have been assimilated into the snow model state variables. Unique snow data observations such as airborne snow water equivalent measurements are reviewed in the text product during the course of operational airborne snow survey missions. Image maps of snow characteristics and other graphics summaries are hyper-linked in the analyses to highlight specific points of interest. The Snow Analyses are prepared each weekday by NOHRSC personnel.

### **4.1 Timing of Observed Snow Data Assimilation and Product Release to AWIPS**

It takes some length of time for snow and precipitation observations to be made, to encode the observations into SHEF, to send the data to AWIPS, to ingest the numerical weather prediction model (RUC) data, to run the NOHRSC snow model with the RUC data, to analyze manually the snow model results along with the relevant snow and precipitation observations, to re-run the NOHRSC snow model to assimilate those snow observations into the snow model, and to release the updated results to the NOHRSC web site and to AWIPS. The snow model assimilation run essentially incorporates snow depth and water equivalent observations that we received during the 24 hour period (6am to 6am central time) of day one and day two (see figure below). We typically complete the generation and posting of a variety of assimilation-run products to our web site by 6am central time on day three. The SHEF and GRIB products released to AWIPS at approximately 6am on day three include the observed snow information that we received on day one and day two. The NOHRSC staff is available from 8am to 5:30pm weekdays to manage the care and feeding of the snow model and to produce and distribute the National Snow Analyses. The figure below gives the timing of the sequence of events from data ingest to product release.



## 4.2 National Snow Analysis

The page defaults to a national map of snow regions and summarizes the national statistics to the right: automated snow model discussion, snow depth, and snow water equivalent. It defaults to the most recent date for which there are data. The region and date of the snow analyses is selectable.

### 4.2.1 Snow Analyses Maps and Seasonal, Two-weeks, and One-day Animations

Below the region and date pull-down menus are nine maps of snow characteristics for the region (default is U.S.): snow water equivalent, snow depth, mean snowpack temperature, 24 hour snow water equivalent change, snow precipitation, snowmelt, blowing snow sublimation, surface sublimation, and non-snow precipitation. Clicking on any of the nine maps gives an enlarged version. Below each map are three buttons titled: animate—season, two-weeks, and one-day. The season animate function gives a pop-up window that loops the daily snow products since October 1. The two-week and one-day animate function provide similar pop-up window that loops the hourly snow products. The map images that provide the animation may take a bit of time to load over slow internet

connections and will display synchronously with the date/time indicator ONLY after all of the images have been loaded on the local machine.

#### 4.2.2 Weather Summary

Below the nine maps is a weather summary text discussion for the region giving salient information and links for the region.

#### 4.2.3 Station Snow Reports

Below the weather summary is a table of the 10 highest snowfall reports for the region. Below the snowfall reports are links to pipe-delimited records that give *all* of the station snowfall reports, snow water equivalent reports, and snow depth reports for the last 24 hours. These data are not currently quality controlled and are posted to our web site as we receive them directly from AWIPS; use with caution.

#### 4.2.4 Model Assimilation

Below the snow reports is a brief text discussion of the office activity associated with snow model assimilation of snow depth and/or snow water equivalent station observations.

#### 4.2.5 NOHRSC Airborne Snow Survey Program

This section provides a text discussion of any planned or recently completed airborne snow survey mission in the selected snow region.

### 4.3 Regional Snow Analyses

The above information is also provided at a higher resolution for each of the 18 snow regions selectable on the U.S. map or from the region and date pull-down menus. Unfortunately, snow analyses are not available for Alaska at this time.

## 5 Interactive Products

The NOHRSC Interactive Snow Information summary gives the end-user the flexibility to produce tailored graphic summaries suited to individual needs and requirements. The graphic maps from the Interactive Snow Information summary can be queried in either metric or English units. The page can be configured for Internet Explorer or Netscape.

Clicking on the Interactive Products button on the side-bar menu gives the Interactive Snow Information page. The upper side-bar menu provides buttons to go to: NOHRSC home, the Snow Analyses pages, quick queries for time-series and text snow products (for users who know their station or basin ids), and interactive help.

## 5.1 Interactive Help

The interactive help page provides information on: (1) navigation, display, and querying the interactive map server, (2) map products and text discussion products, (3) the Airborne Snow Survey Program, and (4) general help.

## 5.2 Default Settings

The interactive snow information page defaults to: (1) full U.S. map, (2) physical element equals snow water equivalent, (3) date equals most recent date and hour for which data are available, (4) zoom in selected (across top), (5) overlays equal states and stations (with labels), and (6) map preferences (lower side-bar menu) equals English units (can be changed to metric units), background image (DEM), 512 pixels map width and height, JavaScript on, Smoothing off, session Cookies off. All of the above options are described on the interactive help page. The scale for the selected physical element is given to the right of the map (or below if selected and refreshed). Unfortunately, we need to use a non-linear scale for the entire country. We don't have the ability to recalculate the scale on-the-fly for each zoom level. The corner lat/long coordinates are given on the map borders along with the east/west and north/south distances.

## 5.3 Interactive Options

It is possible to select any one of a variety of physical elements (e.g., snow water equivalent, snow depth, mean snowpack temperature, 24 hour change in water equivalent or depth, etc.). A variety of map overlays are also selectable from the side-bar menu. The map overlays selected from the side-bar menu have no impact on the query function described below. The date and hour of the map image can be selected.

## 5.4 Cursor Mode

Above the map it is possible to select one of four cursor modes: (1) pan, (2) zoom in, (3) zoom out, and (4) query. It is possible to select the zoom factor from the pull-down menu on the upper right of the map. These functions are fully described on the interactive help (navigation) page. A number of map overlay elements are progressively disclosed as the user zooms in further (e.g., stations, cities, flight lines). For example, more than 18,000 stations are eventually revealed as the map is zoomed in further.

### 5.4.1 Query Mode

The NOHRSC station or basin time-series plots consist of a series of x-y graphic plots that use data from the selected reporting station or basin for the selected period-of-record. The plots include line graphs of NOHRSC snow model output and point indicators for a variety of observed hydrometeorological variables. The default is the station time-series. When the query button is selected from above the map, it is possible to generate time-series plots from the NOHRSC database for the point or area selected from the pull-down

menu. With the query mode and station time-series selected, the user can move the cursor to a specific station on the map and left-click the mouse. A second browser is spawned that gives multiple time-series of modeled and observed information for that station. The station time-series plots include graphs of modeled and/or observed snow water equivalent, snow depth, snow cover, snowmelt, snow surface temperature, mean snowpack temperature, air temperature, snow and non-snow precipitation, sublimation/condensation, various weather forcings, and snow surface energy exchanges. Upon first access, the default dates are the last two weeks and units are English; either can be changed and refreshed. If "cookies are on" the changed date and units will remain for future station queries. Details of the query function are given on the interactive help (querying) page.

#### 5.4.1.1 Alphanumeric Data and Products

Alphanumeric summaries for selected NSA physical elements are available for RFC hydrologic forecast basins on a basin-by-basin basis. Summaries giving mean areal estimates of the selected physical element for RFC hydrologic forecast basins can be grouped by NWS River Forecast Center, by NWS County Warning Area, by USGS Hydrologic Unit Code, by state, or by county. Alphanumeric summaries are available for snow water equivalent, snow depth, and areal extent of snow cover derived from the snow model. The summaries include the basin id, date, minimum and maximum elevation in the basin, basin name (if available), and the mean, standard deviation, minimum, and maximum pixel values of the selected physical element for the basin. If the RFCs have provided elevation zone information for specific basins, the same information is available for each elevation zone. The end-user can select the physical element, the date, and the units (English or metric) for the report.

#### 5.4.1.2 Time-series Plots of Modeled and Observed Data

The time-series plots give both modeled and observed data for the station. Station-specific information is provided in the upper left of the time-series plots and includes: station id and name, latitude/longitude, elevation, start and stop date for the time-series, forest density, and land use. The color-coded legend on the upper right describes the variables plotted. Assimilation (green line) indicates the point in time at which the NOHRSC staff assimilated snow depth or snow water equivalent observations for the region around the station into the snow model states. Snow cover (observed by satellite) is indicated by the colored tick-marks above the first time-series plot. Even if the modeled data and the observed data were perfect, the user should **not** expect the modeled and observed data to agree in all cases. The station data should be representative of a point; the modeled data should be representative of the 1-km<sup>2</sup> pixel in which the station falls. Both might be perfectly correct but not equal. Other time-series options from the pull-down menu are described on the interactive help (querying) page.

#### 5.4.1.3 Time-series Quick Query

From the menu on the left it is possible to select a quick query for the RFC forecast basin time-series information. The user must select an RFC in which the basin resides; a listing of the SHEF IDs for all basins will be revealed; the user can then select the forecast basin by SHEF ID to obtain the time-series information. The user can also enter the station SHEF ID (if known) for a quick query of the time-series information for the selected station.

#### 5.4.1.4 Text Product Quick Query

The user can select text products giving mean areal (and other statistics) snow water equivalent, snow depth, and snow cover for all RFC basins in either the selected: RFC, state, USGS Hydrologic Unit Code, NWS Country Warning Areas, or counties. After the geographic area is selected the data will be reported. It is possible to change the physical element, the date and hour to report the data, and the units (English or metric). These text products can also be retrieved directly from the main interactive snow information page by selecting query and basins by RFC, state, HUC, CWA, or counties.

## 6 Airborne Snow Survey Program

The NOHRSC maintains two snow survey aircraft to make airborne snow water equivalent measurements across a network of over 2200 flight lines covering portions of 31 states (including Alaska) and 8 Canadian provinces. Salient information about the Airborne Snow Survey Program is given on the page including information on: snow survey schedule, airborne photography, flight line index, flight line maps, and airborne snow water equivalent data.

### 6.1 Airborne Flight Line Maps and Airborne Flight Line Index

It is possible to click on Flight Line Maps and retrieve a U.S. map with all of the airborne flight line locations but with no labels. Check at least the following map overlays: flight lines and the labels button to the right of the flight line map overlay box. Select zoom in at the top of the page. Move cursor to region of interest and left click to zoom in (perhaps several times depending on zoom level setting). Eventually the flight line labels will be disclosed. Zoom in further for clarity. The Airborne Flight Line Index is available in ascii format from the airborne page and contains a summary of the total flight line database and includes: flight line id, basin name, NWS region, RFC, WFO, and latitude/longitude/elevation of the flight line mid-point.

### 6.2 Airborne Snow Survey Data and Snow Water Equivalent Maps

Data for each snow survey can be accessed from the Airborne Program page by selecting a "Snow Survey Name". Each survey page gives a text summary of the survey, access to



photos taken by the pilots, a running status map of flight lines flown and lines yet to be flown, and a table giving: Date, States Flown, Survey Status Map, Flight Line Data in SHEF, SWE Image (map of airborne data imposed on SNODAS modeled estimates of snow water equivalent), Discussion, and Used in Assimilation indicator. The SWE Image map indicates the value of the airborne measurement by the color between the two lines representing each flight line. The color contour map represents the modeled snow water equivalent *before* assimilation of the airborne data into the SNODAS model.

## **7 NOHRSC GIS Data Sets**

Available GIS data sets include ESRI shape files that give the vector polygons of the RFC river forecast basins. Each RFC produces their respective shape file basin data sets and ships it to the NOHRSC for our use in generating products. Also included on the page are shape files that describe the 13 RFC perimeter vectors and a shape file that gives the NOHRSC airborne flight line network. All are available for download by the end-user.

## **8 SHEF Archive**

The NWS distributes a variety of hydrometeorological data in Standard Hydrologic Exchange Format (SHEF) that is a human/machine readable text file. The NOHRSC distributes modeled estimates of mean areal snow water equivalent by forecast basin (that include assimilated observations of snow depth and snow water equivalent). The SHEF products are produced and shipped to AWIPS automatically each day at approximately 6am central time for each of the 12 RFCs in the coterminous U.S. The NOHRSC snow water equivalent product includes snow water equivalent by elevation zone within RFC basins if the RFCs have provided to us the elevation break-points for each basin of interest. A second product archived and shipped to the RFCs each day is snow-model-derived areal extent of snow cover (that includes satellite snow cover estimates assimilated into the snow model states). It is possible to select RFC, water equivalent or areal extent of snow cover, and the date and hour for which the snow data are reported.

## **9 Bulletin Board**

The bulletin board is a page on which we post miscellaneous information that does not fit elsewhere on the web site.

## **10 Technology**

The technology page gives a variety of reports, document, papers, and PowerPoint presentations that describe various aspects of the Center's activities, products, and data sets.

## **11 Staff, Directions, Links, Site Help, and Please Send Us Comments**

We hold these pages to be self-evident.

## **12 Gridded National Snow Analyses Products**

The NOHRSC snow model either ingests or generates the variables given in Table 1 below at hourly and 1-km<sup>2</sup> resolutions for the coterminous U.S. Additionally, the NOHRSC generates daily surface temperature products of average daily temperature and freezing and thawing degree-days cumulative since October 1 for the coterminous U.S. at 1-km<sup>2</sup> (Table 2). The NOHRSC is currently working with the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado, who will permanently archive and distribute selected daily, 1-km<sup>2</sup> NOHRSC gridded products for the country (Table 3). NSIDC is in the process of developing an on-line distribution system whereby any end users can access and select any of the available gridded products (Table 3) for their required spatial and temporal domain. Selected gridded NOHRSC products starting October 1, 2003, are available now from NSIDC.

In addition, the NOHRSC has the ability to generate and to ship automatically, in near real-time, 1-km<sup>2</sup>, hourly or daily gridded products for all of the snow model and cumulative surface temperature variables summarized below for use in special projects (Tables 1 and 2). The NOHRSC will limit the volume of gridded data shipped directly to end users to avoid overloading the available, and limited, Internet bandwidth. Additionally, the NOHRSC can only generate and ship gridded products directly in near real-time. We do not currently have the capability to archive or to regenerate the gridded products for use at a later date. The hourly or daily gridded products can be shipped, in near real-time, directly by the NOHRSC for the following geographic units: coterminous U.S., River Forecast Center, County Warning Area, or state.

<b>Table 1: Snow Model Input and Output Variables</b>	
<b><i>Driving Data</i></b>	<b><i>Diagnostic Variables</i></b>
Surface zonal wind	Blowing snow sublimation rate
Surface meridional wind	Latent heat flux
Surface air temperature	Melt rate
Surface relative humidity	Net long wave radiation flux
Snow precipitation	Net solar radiation flux
Non-snow precipitation	Sensible heat flux
Solar radiation	Snowpack sublimation rate
<b><i>State Variables</i></b>	Snowpack surface temperature
Snow water equivalent	
Snowpack internal energy	
Snowpack thickness	
Snowpack average temperature	
Snowpack unfrozen fraction	

<b>Table 2: U.S. Surface Temperature Products</b>
Average daily temperature
Cumulative freezing degree days (since October 1)
Cumulative thawing degree days (since October 1)

<b>Table 3: Daily NOHRSC Products Archived at and Available from NSIDC</b>	
<b><i>Physical Element</i></b>	<b><i>Remarks</i></b>
Snow precipitation	24-hour total, 6Z-6Z
Non-snow precipitation	24-hour total, 6Z-6Z
Snow water equivalent	snapshot, 6Z
Snowpack thickness	snapshot, 6Z
Blowing snow sublimation	total of 24 "per-hour" sublimation rates, 6Z-6Z
Snowpack sublimation	total of 24 "per-hour" sublimation rates, 6Z-6Z
Average snowpack temperature	Average of the 24 hourly vertically averaged snowpack temperatures
Melt	total of 24 "per-hour" melt rates out of bottom of the snowpack, 6Z-6Z

#### 12.1 How to Obtain Gridded NOHRSC Products from NSIDC.

NSIDC anticipates having a web-based data query and download function available for NOHRSC gridded data by mid-2004. Once the process is in place, this document will be updated and an example of how end users can access the NOHRSC gridded data from NSIDC will be provided in this section. Even though the web-based gridded product download capability is not yet in place at NSIDC, it is possible to request NOHRSC gridded products directly from NSIDC today. Contact Florence Fetterer ([fetterer@kryos.colorado.edu](mailto:fetterer@kryos.colorado.edu)) for further information on the process to acquire NOHRSC gridded data sets from NSIDC in Boulder.

### 13 NOHRSC Products on AWIPS

Daily NOHRSC GRIB products of snow water equivalent, snow cover, and snow cover by elevation are available for the coterminous U.S. on AWIPS D-2D. Additionally, mean areal basin estimates of snow water equivalent are distributed, in SHEF, over AWIPS daily. (See section 8.)

### 14 NOHRSC CD-ROMs

The NOHRSC has been publishing CD-ROMs annually since 1990 that contain most of the image and alphanumeric products generated each year. NOHRSC CD-ROMs are available upon request.

## 15 Contact Information

All questions, suggestions for improvement, and requests for additional information or gridded products and data sets should be addressed to:

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